injection test. This increase in pressure was not considered significant and, after approximately 2 days, the rate of change of pressure with time was similar to the rates for the test before heat injection.

In October 1982, a precipitation filter was installed in the above-ground piping between the heat exchanger and production well A (fig. 3) to reduce precipitation of calcium carbonate on the well screen during future testing. The precipitation filter consisted of two sets of three tanks approximately 1.8 m long and 0.36 m in diameter connected in series and filled with a graded, high-purity limestone aggregate. Heated water was pumped through the tanks where calcium was allowed to precipitate out of solution onto the limestone.

The limestone filter effectively reduced the degree of calcium carbonate supersaturation and reduced the potential for calcium carbonate precipitation within the well bore; however, because water was pumped through the heat exchanger before it was filtered, calcium carbonate precipitation was not reduced within the heat exchanger. Precipitation of calcium carbonate within the heat exchanger resulted in increased pressures in the above-ground pipeline (fig. 3). Consequently, it was necessary to clean the heat exchanger with acid during subsequent tests after approximately every 40 hours of operation to remove all carbonate precipitate. The limestone filter material was replaced with new aggregate while the heat exchanger was cleaned. Maintenance of the filters and heat exchanger required 8 to 15 hours.

SHORT-TERM TEST CYCLES I–IV

Four short-term test cycles of heat injection were conducted from November 1982 through December 1983. The duration, average rate of injection and withdrawal, and average temperature during injection for the four short-term test cycles are summarized in table 1. The time required for removing the carbonate precipitate from the heat exchanger and for changing the graded limestone material in the precipitation filters interrupted the injection period of each cycle; therefore, the total calendar time of the injection period for a particular cycle was longer than the total storage or total withdrawal periods, although the actual time of heated water injection was approximately equal to that of storage and withdrawal. Four maintenance periods were needed during each of the four test cycles; the result was five individual injection periods (termed heat 1 through heat 5 in this report) within each respective cycle (fig. 9). For example, the total duration of

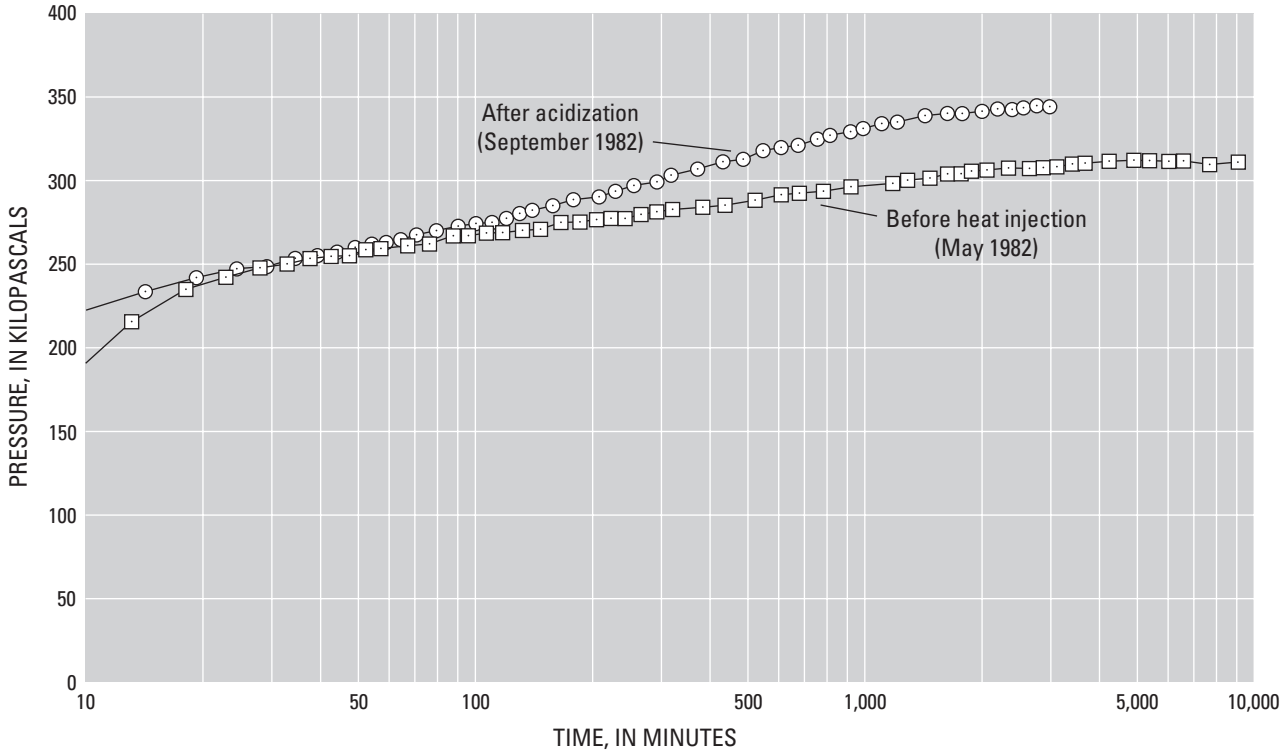

Figure 8. Pressure changes in production well A during injection at 18.6 liters per second before heat injection and after redevelopment by acidization.